Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-27-RC2, 2018

Annales Geophysicae Discussions
Open Access
EGU

Interactive comment on "Estimating ocean tide model uncertainties for electromagnetic inversion studies" *by* Jan Saynisch et al.

R. TYLER (Referee)

robert.h.tyler@nasa.gov

Received and published: 1 June 2018

General:

The review posted by Jakub Velimsky provides an excellent overview of this paper as well as general comments I agree with. My review here concerns only a few extensions to these comments as well as some technical points.

Recent interest in the ocean tidal generated magnetic signal is important as both the tides and seawater conductivity are expected to be fairly stable, with the result that the ocean tides probably provide the most predictable large-scale, naturally occurring EM source for probing the mantle and possibly the ocean conductivity. Given that the EM wavelengths in the open ocean are long for periods above 10 minutes, the tidal

Printer-friendly version

Discussion paper

EM process is essentially 2D and the recoverable ocean parameters from magnetic data involve only conductance and conductivity transport. These in turn may translate as ocean heat content and heat transport and so this study is extremely relevant to analyzing the potential exploitation of magnetic observations in ocean/climate variability studies. (In a sense, the salinity dependence on conductivity is diminished when considering these depth integrals.) This study largely confirms this expectation and provides useful quantified values, as well as quantification of uncertainties inherent in the variation in tidal models.

A concern I have (which only makes the study incomplete rather than incorrect) is in the assumption that the 3D tidal model of Kuvshinov is the most appropriate. As mentioned above, at tidal periods the EM process is 2D and so there is no benefit to a 3D model on this ground (when interest is in the remote magnetic fields). As mentioned by Velimsky, the interpolation to 1 deg. resolution (from the native 1/6 of the tidal data) is a concern. This concern affects not just small scales but also large scales as the induction equation clearly shows communication of energy between scales (i.e. large scale results can be affected by lack of sufficient high resolution). Most importantly, with the transfer of sources to lower resolution, the fluid-dynamical properties implied may not retain the conservation principles they had in the original form on the native ocean model grid. (In my own modeling of tidal magnetic signals, I adopt the full 1/6 degree resolution and native grid of the ocean tidal model for these reasons—even though interest remains in the large scale aspects of the final results). The 3D Kuvshinov model does provide galvanic contact with the mantle. While my modeling approach has high resolution, it has inductive but not galvanic contact and this is potentially a weakness—though not yet apparent in comparisons with observations.

As there are different strengths and weaknesses in these and other EM modeling approaches, the variability in ocean tidal magnetic signals needs to consider not just the variability in the oceanographic tidal modes but also in the EM fields used to generate the magnetic signals. The study here considers one of these, which is a reasonable

start.

Technical Points:

L7: "analyzes" is the verb "analyses" is the plural noun. Subtle for sure.

L12: "can not" -> "cannot"

L16/17: Reword for clarity (important because it describes the goal of the study)

L18: "As" -> "As in"

L26: which "that" the second?"

L30: is based on the ephemerides...of the Moon?

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2018-27, 2018.

Printer-friendly version

Discussion paper